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Evaluation of the Efficacy of the Poly-L-Lactic Acid Thread and Platelet Rich Plasma in Treatment of Atrophic Scars

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Atrophic scars are the result of insufficient compensation of dermal collagen and decreased production of connective tissue during tissue injury healing. The aim of the study was to evaluate the efficacy of Poly-L- Lactic Acid (PLLA)threads and Platelet Rich Plasma (PRP) in the treatment of atrophic scar.
Methods: This study included 24 patients with atrophic scar for at least one year and did not receive any treatment in the last six months. Cases were divided into 3 equal groups: group (A) received subcision with PLLA threads insertion, group (B) received subcision with PLLA threads insertion and PRP. PRP injected monthly for four sessions and group (C) received subcision with PRP injection monthly for four sessions. general examination, detailed dermatological examination, routine investigations, digital photography: Photographic evaluation was done with the same equipment, lighting and location by 3 dermatologists, and skin biopsies.

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Results: There was a significant enhancement in the Global aesthetic improvement scale in both group A and B than group C (p=0.047, 0.017) respectively. In group (A), there was significant negative correlation between duration of scar and the degree of clinical improvement (r -0.961/ p value<0.001) while in group (B) and (C), there was insignificant correlation between duration of scar and the degree of clinical improvement.
Conclusions: PLLA threads alone and combined with PRP injection could be deemed as a safe and useful in the management of atrophic scars.

Keywords: Poly-L-lactic acid thread; platelet rich plasma; atrophic scars.

1. INTRODUCTION

Atrophic scars are a common aesthetic issue. It is caused by insufficient compensation of dermal collagen and reduced the connective tissue production during the healing process following tissue injury [1].

Numerous procedures, such as chemical peels, dermabrasion, punch grafting, and the use of fillers to augment depressed areas, are used to treat atrophic scars [1].

Platelet-rich plasma (PRP) is an autologous, highly concentrated plasma solution prepared from the patient's own blood. Platelets play a crucial role in tissue repair through the release of numerous growth factors. These factors adjust the cell proliferation, migration, attachment, and differentiation, and they promote accumulation of extracellular matrix by binding to specific cell surface receptors [1].

Poly-L-Lactic Acid (PLLA) thread is manufactured from polylactic acid and consists of 82% L-lactic acid and 18% glycolide. Because they are absorbent, biodegradable, and minimally immunogenic, PLLA threads are frequently used for facial rejuvenation [2]. Polylactic acids mostly used for filling and stimulates collagen production [3]. Therefore, we hypothesize that it may be useful for treating atrophic scars.

We aimed to assess the effectiveness of PLLA threads and PRP in the treatment of atrophic scars.

2. METERIALS AND METHODS

This study enrolled 24 cases with atrophic scar for at least one year and didn't have any treatment in the last six months.

Exclusion criteria were pregnancy, breast-feeding females, patients with immunosuppression or being under any kind of treatment, suffering from (or had history of) any coagulation or thrombophilic condition, using non-steroidal anti-inflammatory drugs, systemic corticosteroids, anticoagulants such as aspirin, warfarin, etc., hepatic insufficiency, diabetes mellitus ,cardiovascular disorders, thyroid disorders, hepatitis, cancer, and with any chronic diseases such as chronic renal failure, etc. Patients were divided into 3 equal groups: group (A) received subcision with PLLA threads insertion, group (B) received subcision with PLLA threads insertion and PRP injection. PRP injected monthly for four sessions and group (C) received subcision with PRP injection monthly for four sessions.

All participants underwent: Full history taking, general examination, detailed dermatological examination, laboratory investigations, digital photography: Photographic evaluation was done with the same equipment, lighting and location by 3 dermatologists and skin biopsies.

Platelet rich plasma was prepared by double spin method [4]: Venous blood (Ten cc)was drawn from the antecubital vein and collected in sterile, disposable tubes containing sodium citrate in a 1:10 ratio as an anticoagulant.

Blood that had been citrated was subjected to two centrifugation processes. The initial centrifugation (soft spin) lasted 7 minutes at 3000 rpm, whereas the second centrifugation phase (hard spin) lasted 5 minutes at 4000 rpm. The pellet containing platelets settled to the bottom PRP. PRP was then recovered and activated by the addition of calcium chloride (CaCl) immediately before the injection (1:10), 0.1 cm CaCl to each 1 cm of PRP.

2.1 Subcision

Topical anaesthetic cream (Pridocaine) was applied for 30 minutes, before subcision, skin was disinfected by alcohol 70%. The patients

were injected by mepivacaine hydrochloride with adrenaline.

2.2 Plasma Injection

Before PRP sessions, topical anaesthetic cream (Pridocaine) was applied for 30 minutes. The plasma was injected by sterile disposable insulin syringe intradermally and subcutaneously in the atrophic scar with a space of 1 cm between different points of injections.

2.3 Poly -L-Lactic Acid Threads Insertion

PLLA Threads used, was I Thread that made in Korea Sole agent Iris company in Middle East. The needle trocar was introduced through the skin and advanced along the atrophic scar pathway. The trocar was removed, and the thread was inserted in the same tunnel done by subcision needle.

2.4 Statistical Analysis

The IBM SPSS software package, version 20.0, was used for both data entry and analysis. IBM Corporation, Armonk, New York. Descriptions in numbers and percentages were supplied for qualitative information. The distribution's normality was checked using the Kolmogorov-Smirnov test. In order to define quantitative data, we employed measures such as range (minimum and maximum), mean, standard deviation, median, and interquartile range (IQR). The collected data was considered to be statistically significant at the 5% level. Chi-square, Monte Carlo, F, Kruskal-Wallis, and t-tests were employed for comparisons. Statistical significance was assumed at a 0.05 level of probability.

2.5 Clinical Results

Group (A): treated with PLLA threads

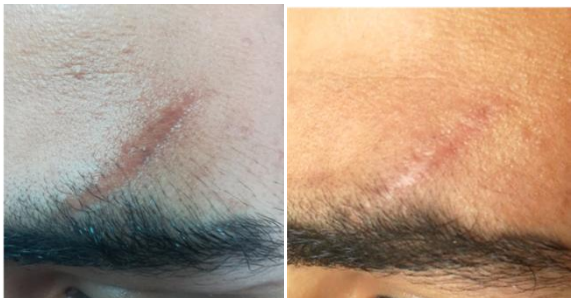


Photo 1. A16 years old male with post traumatic atrophic scar

(A) Before treatment.
(B) At the end of follow up with excellent improvement, excellent Global aesthetic improvement scale.

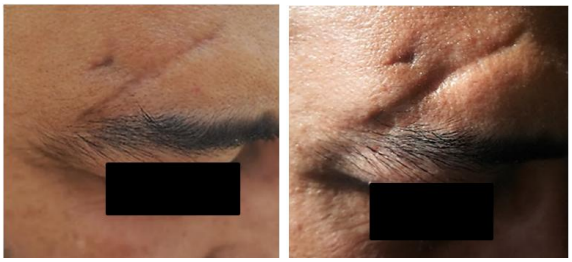


Photo 2. A44 years old male with post traumatic atrophic scar

(A) Before treatment.
(B) At the end of follow up with good improvement, marked Global aesthetic improvement scale

Group (B): treated with PRP and PLLA threads

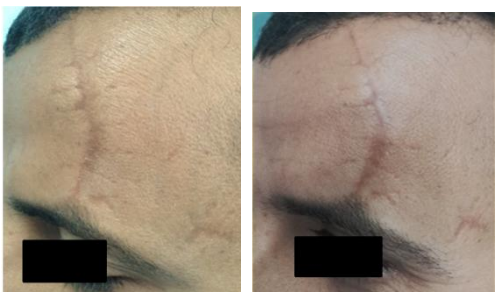


Photo 3. A39 years old male with post traumatic atrophic scary

(A) Before treatment .
(B) At the end of follow up with good improvement, marked Global aesthetic improvement scale

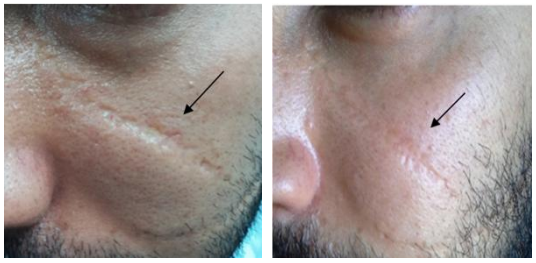


Photo 4. A45 years old male with post traumatic atrophic scar

(A) Before treatment .
(B) At the end of follow up with excellent improvement, excellent Global aesthetic improvement scale.

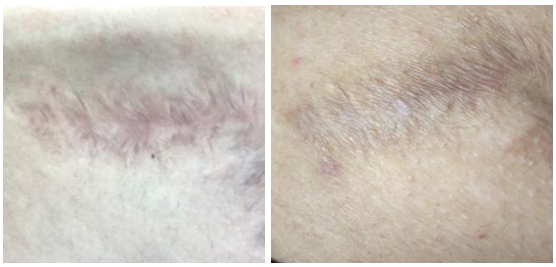


Photo 5. A22 years old female with post traumatic atrophic scar

(A) Before treatment .
(B) At the end of follow up with moderate improvement, moderate Global aesthetic improvement scale.

Group (C):treated with PRP injection

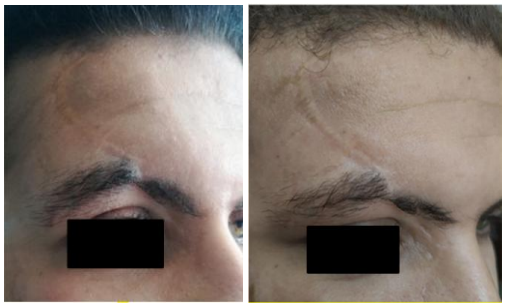
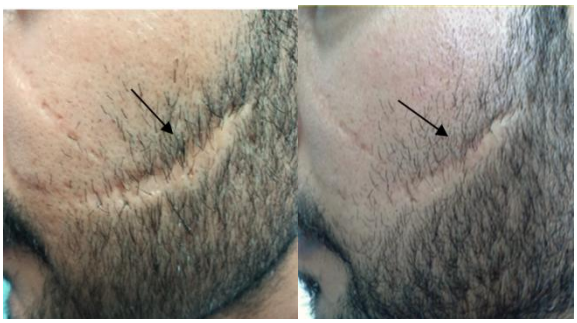


Photo 6. A22 years old male with post traumatic atrophic scar

(A) Before treatment.
(B) At the end of follow up with fair improvement , moderet Global aesthetic improvement scale.



Photo(7):A45 years old male with post traumatic atrophic scar

(A) Before treatment.
(B) At the end of follow up with fair improvement, moderet Global aesthetic improvement scale.

3. RESULTS

There was insignificantly different as regard sex, age, occupation, family history, accidental cause, course, and duration of scar among the studied groups.

Site of scars was insignificantly different among the studied groups. There was statistically significant enhancement in the Global aesthetic improvement scale in group A and B when than group C (p=0.047, 0.017) respectively and there was insignificant difference between group A and B.

There was a significant enhancement in group A and B than group C (p=0.047, 0.017 respectively.) While there was insignificant difference between group A and B. Patients' satisfaction was statistically significant higher in group A and B than group C (p=0.047, 0.017) respectively. While there was insignificant difference between group A and Bز

There was a significant improvement in the modified Manchester scale after treatment in group A and B than in group c with no significant difference between group A and B(p=0.025,0.004*) respectively.

There was an insignificant relation between the percentage of improvement and the site of the scar in all the studied groups.

In group (A) duration of scar was negatively correlated with the degree of clinical improvement (r -0.961/ p value<0.001) while in group (B) and (C), with no significant correlation between duration of scar and the degree of clinical improvement. Fig. 1.

3.1 Histopathological Results

Before treatment, hematoxylin and eosin stain section revealed atrophic scar with minimal collagen fibers in the dermis with mild inflammation cells and vascular spaces Fig. (1). Group (C) section revealed mild increase in collagen fibers and vascular spaces in the dermis with mild infiltration by inflammatory cells Fig. (2). Group (A) section revealed moderet increase in collagen fibers and vascular spaces in the dermis with moderet infiltration by inflammatory cells Fig. (3). Group (B) section revealed marked increase in collagen fibers and vascular spaces in the dermis with marked infiltration by inflammatory cells Fig. (4).

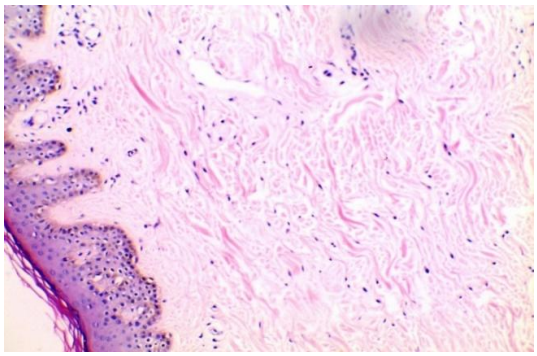


Fig. 1. Section reveled atrophic scar (before treatment) showed minimal collagen fibers in the dermis with mild inflammatory cells and vascular spaces [H&E × 400]

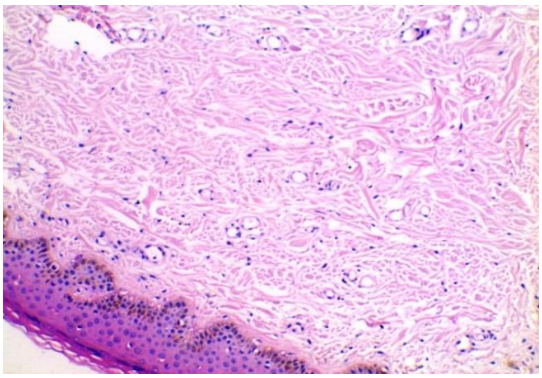


Fig. 2. Section revealed atrophic scar (after treatment with Platelet-Rich Plasma injection) showed mild increase in collagen fibers and vascular spaces in the dermis with mild infiltration by inflammatory cells [H&E × 400]

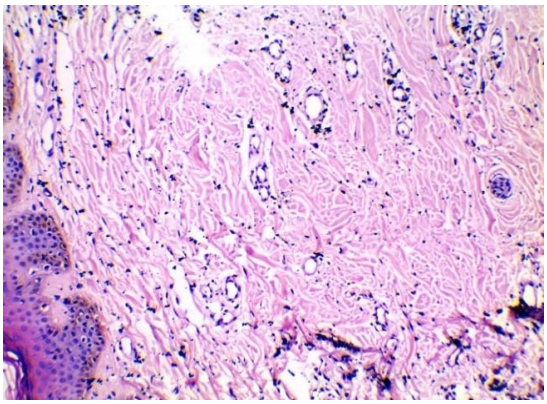


Fig. 3. Section revealed atrophic scar (after treatment with Poly -L-Lactic Acid Threads insertion) showed moderet increase in collagen fibers and vascular spaces in the dermis with moderet infiltration by inflammatory cells [H&E × 400]

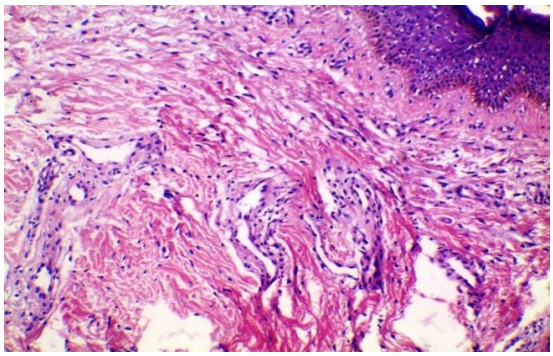


Fig. 4. Section revealed atrophic scar (after treatment with Poly -L-Lactic Acid Threads insertion and Platelet-Rich Plasma injection) showed marked increase in collagen fibers and vascular spaces in the dermis with marked infiltration by inflammatory cells [H&E × 400]

Before treatment, trichrome stain section revealed atrophic scar with minimal collagen fibers infiltration in the dermis Fig. (5). Post PRP treatment sessions section revealed mild in increase in collagen fibers infiltration in the dermis Fig. (6). Post Poly -L-Lactic Acid Threads insertion section revealed moderet increase in collagen fibers infiltration in the dermis Fig. (7). Post Poly -L-Lactic Acid Threads insertion and PRP injection section revealed marked increase in collagen fibers infiltration in the dermis Fig. (8).

4. DISCUSSION

Atrophic scars are dermal depressions often generated by collagen loss during tissue healing after surgery or trauma, or during an inflammatory skin illness such as psoriasis (varicella and cystic acne) [1].

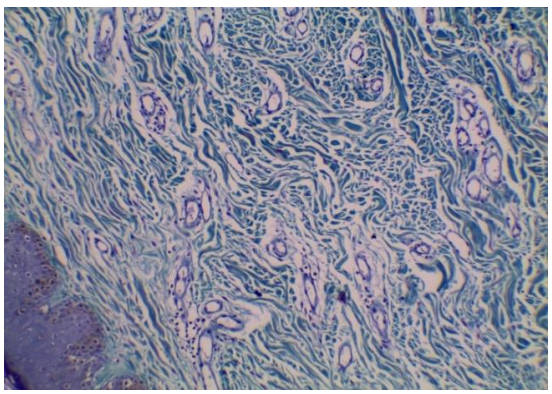


Fig. 5. Section reveled atrophic scar (before treatment) showed minimal collagen fibers infiltration in the dermis [trichrom×400]

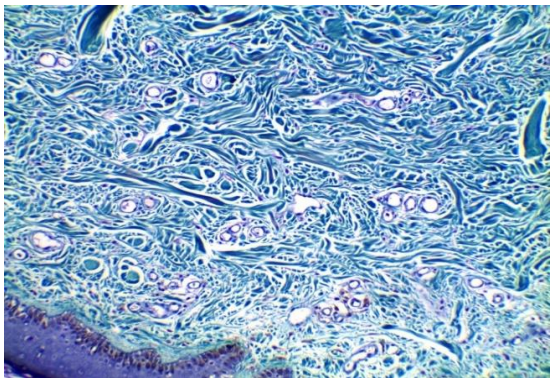


Fig. 6. Section revealed atrophic scar (after treatment with Platelet-Rich Plasma injection) showed mild collagen fibers infiltration in the dermis[trichrom×400]

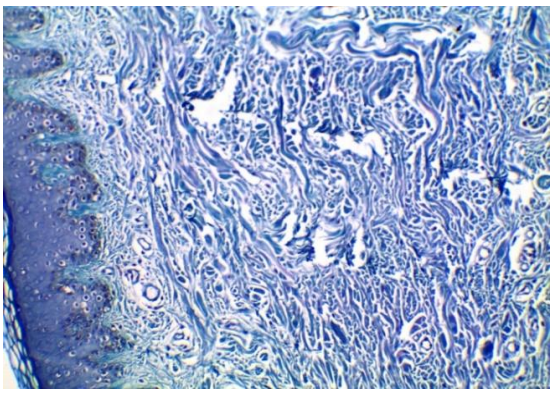


Fig. 7. Section revealed atrophic scar (after treatment with Poly -L-Lactic Acid Threads insertion) showed moderet collagen fibers infiltration in the dermis [trichrom×400]

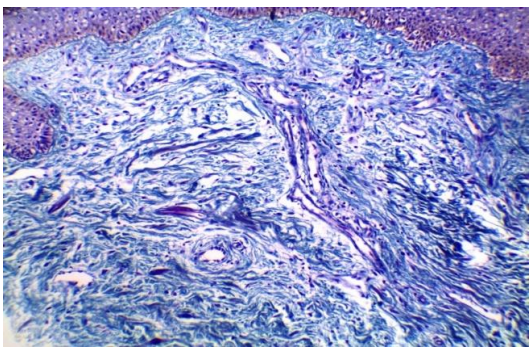


Fig. 8. Section revealed atrophic scar (after treatment with Poly -L-Lactic Acid Threads insertion and Platelet-Rich Plasma injection) showed marked collagen fibers infiltration in the dermis [trichrom×400]

Our findings revealed that, all cases in group A treated with subcission with PLLA threads injection had scar appearance improvement. The improvement was excellent in 62.5% of the patients, good in 25.0% of the patients and fair in 12.5% of the patients. All cases in group B treated with subcission with PLLA threads insertion and PRP injection had scar appearance improvement. The improvement was excellent in 75.0% of the patients, good in 12.5% of the patients and fair in 12.5% of the patients.

All cases in group C treated with subcision and PRP injection had enhancement of the scar appearance. The improvement was excellent in 12.5%of the patients, good in 12.5% of the patients and fair in 75.0%of the patients.

It was previously reported that PLLA had collagen stimulating activity leading to revolumization and improvement in skin quality, when used for mid face lift [5].

Shin et al. [6] found that the use of multiple twisted thread increased the structure of collagen. The collagen formation in PLA monofilament thread was found more than in PDO double thread. At two weeks, the single-stranded PLA thread produced not only more Collagen 1 than the double-stranded PDO thread, but also the most Collagen 3.

An et al. [7] found that combining topical poly-lactic acid with microneedle fractional radiofrequency for the treatment of acne scars resulted in considerably superior clinical results, including improved scar smoothness and reduced scar size.

Ibrahim and Elgarhy et al. [8], stated that The evaluation of the PSP technique, which includes dot peeling, subcision, and intradermal injection of PRP for the treatment of atrophic post-acne scars, revealed that three months after the last session 30% had mild improvement. 20% had moderate improvement 20% had good improvement , and 30% of patients had excellent improvement.

We observed that there was a substantial improvement between groups A and C, and that there was a considerable improvement between groups B and C.

Subcision was used to get rid of the fibrous components under the scar in our study during the subcutaneous stage. This aids the body's natural healing process, speeding up the removal of scar tissue and the development of connective tissue [9].

Table 1. Demographic data of the studied patients

		Group A (n= 8)	Group B (n= 8)	Group C (n= 8)	Test of sig.	P
Sex	**Male**	5(62.5%)	5(62.5%)	7(87.5%)	c2=	0.618
	Female	3(37.5%)	3(37.5%)	1(12.5%)	1.667	
Age (years)	**Range**	16.0 – 55.0	20.0 – 45.0	16.0 – 54.0	F=	0.957
	Mean ± SD.	30.88 ± 14.31	30.50 ± 9.70	32.25 ± 12.91	0.044	
Occupation	**Student**	3(37.5%)	3(37.5%)	3(37.5%)	c2=	1.000
	Worker	5(62.5%)	5(62.5%)	5(62.5%)	0.181	
Family history		0(0.0%)	0(0.0%)	0(0.0%)		
Cause(accidently)		8(100.0%)	8(100.0%)	8(100.0%)	-	-
Course	**Stationary**	6(75.0%)	7(87.5%)	7(87.5%)	c2=	1.000
	Progressive	2(25.0%)	1(12.5%)	1(12.5%)	0.772	
Duration of Scar (months)						
Range Mean ± SD.		24.0 – 360.0	12.0 – 360.0	24.0 – 420.0	H= 1.239	0.538
		112.50 ± 109.22	87.0 ± 116.12	139.50 ± 158.54		
Median (IQR)		84.0 (42.0 – 132.0)	48.0 (18.0 – 96.0)	66.0 (30.0 – 240.0)		

χ2: Chi square test, H: H for Kruskal Wallis test, F: F for ANOVA test, Data are represented by mean ± SD, median or number (%)

Table 2. Site of scars and global aesthetic improvement scale in the studied groups

Site of scar	Group A (n= 8)	Group B (n= 8)	Group C (n= 8)	c2	MCp
Cheek	2(25.0%)	4(50.0%)	4(50.0%)	7.703	0.484
Chin	0(0.0%)	1(12.5%)	0(0.0%)		
Eye brow	3(37.5%)	0(0.0%)	1(12.5%)		
For head	2(25.0%)	3(37.5%)	3(37.5%)		
Perioral	1(12.5%)	0(0.0%)	0(0.0%)		
GAIS					
Moderate	1(12.5%)	1(12.5%)	6(75.0%)	9.375*	0.029*
Marked	2(25.0%)	1(12.5%)	1(12.5%)		
Excellent	5(62.5%)	6(75.0%)	1(12.5%)		
	MCp1=1.000, MCp2=0.047*, MCp3=0.017*				

*Data are represented by number (%), GAIS: Global aesthetic improvement, p1: p value between group A and group B, p2: p value between group A and group C, p3: p value between group b and group C, *: Statistically significant as p ≤ 0.05, □2: Chi square test, MC: Monte Carlo*

Table 3. Degree of improvement and patient satisfaction in the three studied groups

Improvement Fair	**Group A(n= 8)**	**Group B(n= 8)**	**Group C(n= 8)**	**Test of sig.**	**P MCp=0.029***
	1(12.5%)	1(12.5%)	6(75.0%)		
Good	2(25.0%)	1(12.5%)	1(12.5%)	9.375*	
Excellent	5(62.5%)	6(75.0%)	1(12.5%)		
Significant between groups	MCp1=1.000, **MCp2=0.047***, **MCp3=0.017***				
Range	35.0 – 90.0	30.0 – 95.0	30.0 – 90.0	F=	0.006*
Mean ± SD.	74.38 ± 17.61	75.63 ± 22.11	43.13 ± 21.37	6.480*	
Significant between groups	p1=0.992, **p2=0.016*, p3=0.012***				
Patient satisfaction					
Slight satisfied	1(12.5%)	1(12.5%)	6(75.0%)	9.375*	**0.029***
Satisfied	2(25.0%)	1(12.5%)	1(12.5%)		
Very satisfied	6(75.0%)	6(75.0%)	1(12.5%)		
Significant between groups	MCp1=1.000, **MCp2=0.047***,	**MCp3=0.017***			

*Data are represented by mean±SD , median or number (%),p: p value between the studied groups, p1: p value between group A and group B, p2: p value between group A and group C, p3: p value between group b and group C, *: Statistically significant at p ≤ 0.05*

Table 4. Relation between percentage of improvement and site of scar in each group

Site of scar	**N**	**Improvement**			**Test of Sig.**	**P**
		Min. – Max.	**Mean ± SD.**	**Median**		
			Group A			
Cheek	2	80.0 – 90.0	85.0 ± 7.07	85.0	F=	0.320
Eye brow	3	35.0 – 80.0	61.67 ± 23.63	70.0	1.534	
For head	2	80.0 – 90.0	85.0 ± 7.07	85.0		
			Group B			
Cheek	4	30.0 – 95.0	68.75 ± 30.10	75.0	t=	0.621
For head	3	70.0 – 85.0	78.33 ± 7.64	80.0	0.527	
			Group C			
Cheek	4	30.0 – 90.0	47.50 ± 28.43	35.0	t=	0.766
For head	3	30.0 – 60.0	41.67 ±16.07	35.0	0.315	

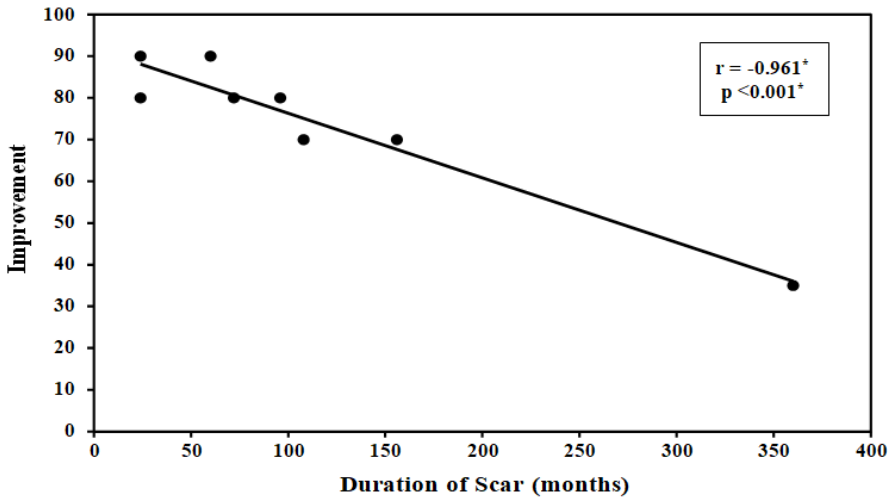


Fig. 9. Correlation between improvement and duration of scar in group A

Additionally, PLLA threads increase dermis thickness, and stimulate collagen production. Threads contain antibacterial filaments that are absorbed physiologically and display tissue-lifting properties that aid in skin regeneration. The immunological and inflammatory effects are likewise mild with these strands [2].

Regarding safety assessment of therapeutic technique in the present study, pain during session was tolerable as we inject anesthesia before we start. All patients developed edema and ecchymosis immediately after the session which resolve in 5 to 7 days. There was no complication developed in our patients during the follow up period. The side effects in our study are negligible.

In the study of Sarigul et al. [10] The safety and side effects of absorbable threads manufactured from PLLA and poly lactide/ glycolide were investigated. They discovered that the poly lactide/glycolide treatment is largely risk-free and devoid of severe problems. The most prevalent consequence identified was skin dimpling and irregularity, as well as suture extrusion without emergence from the skin. Hematoma and infection were seen seldom.

Regarding patients' satisfaction in group A treated with PLLA threads 62.5% of the patients were very satisfied, 25.0% satisfied and 12.5% slightly satisfied. In group B treated with PRP and PLLA threads 75.0% of the patients were very satisfied, 12.5% satisfied and 12.5% slightly satisfied. patients' satisfaction in group C treated with PRP injection 12.5% of the patients were very satisfied, 12.5% satisfied and 75.0% slightly satisfied.

Lee et al. [11] found that PLLA is bioresorbable implantation materials which have gained popularity and demonstrated safety in the clinical uses.

In the current study, the histopathological results after three months confirmed the clinical results as it revealed improvement in the three groups with increase in collagen fibers and vascular spaces in the dermis with mild to moderate infiltration by inflammatory cells. The collagen formation was marked in group B, moderate in group A.

This was in agreement with Goldberg et al. [5] used absorbable PLLA/PLGA monofilament sutures in midface lift and histopathology revealed that Collagen deposition was apparent at day 90 and increased significantly.

An et al., 2020 [7], observed that polylactic acid functions as a biostimulant to increase collagen formation and vascularization of existing collagen, according to research. Collagen synthesis starts six to eight weeks after injection and continues for nine to twelve months. although Kim et al. [12] using barbed mono-PDO threads, increased collagen levels were shown to last for up to 7 months.

However, Shin et al. [6] found that 2 weeks after implantation, various PDO filaments generated greater collagen (Col11, Col3).PLA is another common dermal filler material that provides a biostimulatory effect by coordinating macrophages, fibroblasts, and collagen via capsule formation. This delayed breakdown period of PLA into water and carbon dioxide is

responsible for the increased creation of collagen, which spans from 9 to 30 months.

5. CONCLUSION

Single session of PLLA threads injection could be deemed as a safe and effective treatment modalityin atrophic scars. Combining PLLA threads with PRP enhances the efficacy of treating atrophic scars. Injections of PLLA threads increase collagen synthesis, neovascularization, and revolumization of scars. No major adverse effects were recorded as a result of the method.

CONSENT AND ETHICAL APPROVAL

The study was conducted after approval of the research Ethics Committee (32889/01/19), Faculty of Medicine, Tanta University hospitals. A written informed consent was taken from all patients.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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